said scan-deflection means having X-Y coordinates of deflection for area coverage at least within the perimeter of said [central area] limited field, adjustable means for angular selection of the orientation of said coordinates to position one to the exclusion of the other of said coordinates in oriented [alignment with the] relation to the ascertained astigmatism axis of the [eye] cornea to be operated upon, and means including a microprocessor for establishing a series of different centrally related perimeter limits of generally rectangular-area scan within the perimeter of said [central area] limited field and for coordinating the operation of said scan-deflection means in a controlled program of limitation of one area scan within one perimeter limit before repeating such coordination within the next-successive perimeter limit in the series, the successively scanned areas being of varying width and symmetrical about a central axis aligned with said astigmatism axis, [said laser means including means for adjusting beam-exposure flux to a level at which resultant corneal-tissue ablation per unit time is to an ascertained elemental depth which is but a fraction of desired maximum depth of ablation into the stroma region of the cornea,] whereby ablative penetration to said maximum depth is the cumulative result of plural area scans of each of a succession of different but overlapping rectangular areas[.] , with astigmatism-reducing cornea-curvature correction.

C1 contd.

Claim ~~8.~~ 2 (Amended) [Astigmatism apparatus] Apparatus according to claim ~~7,~~ 1 and including means for effectively limiting to the perimeter of said [central area] limited field the component of scan in said one-coordinate orientation.

Claim ~~9.~~ 3 (Amended) [Sculpture apparatus for reduction of an ascertained astigmatic condition in the central area of the external surface of the cornea of an eye of a patient,] Apparatus for performing ophthalmological surgery to reduce an ascertained astigmatic condition by selective ablation of the anterior surface of the cornea with penetration into the stroma to achieve a volumetric removal of corneal tissue, said apparatus comprising laser means having a chassis and

producing an output beam in the ultraviolet portion of the electromagnetic spectrum and characterized by a spot which at eye impingement is small [compared to said area] in relation to the cornea to be operated upon, said laser means including means for adjusting beam-exposure flux to a level at which corneal-tissue ablation per unit time is to an ascertained elemental depth which is but a fraction of desired maximum depth into the stroma region, scan-deflection means positioned for deflection of said beam in a limited field about a central axis, [body-engageable] means for steadying [one eye of the patient] the cornea with respect to said chassis and with the central area of the cornea centered on the central axis of scan deflection of said beam, said scan-deflection means having two coordinates of deflection for area coverage within the perimeter of said [central area,] limited field, [said laser including means for adjusting beam-exposure flux to a level at which resultant corneal-tissue ablation per unit time is to an ascertained elemental depth which is but a fraction of desired maximum depth of ablation into the stroma region of the cornea,] and means including a microprocessor for coordinating the operation of said scan-deflection means in a controlled program of area coverage to establish greatest cumulative beam exposure along the alignment of the central axis of symmetry of the ascertained astigmatic condition, with cumulative beam exposure decreasing smoothly as a function of increasing lateral offset on both sides of said central axis of symmetry.

Add claims 25 to 28, as follows:

-- ~~25.~~ Apparatus for performing ophthalmological surgery to reduce an ascertained astigmatic condition by selective ablation of the anterior surface of the cornea with penetration into the stroma to achieve a volumetric removal of corneal tissue, said apparatus comprising laser means having a chassis and producing an output beam in the ultraviolet portion of the electromagnetic spectrum and characterized by a spot which at eye impingement is small in relation to the cornea to be operated upon, said laser means including

means for adjusting beam-exposure flux to a level at which corneal-tissue ablation per unit time is to an ascertained elemental depth which is but a fraction of desired maximum depth into the stroma region, scan-deflection means positioned for deflection of said beam in a limited field about a central axis, means for steadying the cornea with respect to said chassis and with the central area of the cornea centered on the central axis of scan deflection of said beam, said scan-deflection means having X-Y coordinates of deflection for area coverage at least within the perimeter of said limited field, adjustable means for angular selection of the orientation of said coordinates to position one to the exclusion of the other of said coordinates in oriented relation to the ascertained astigmatism axis of the cornea to be operated upon, and control means with coordinating control connections to said scan-deflection means and to said laser for establishing a series of different centrally related perimeter limits of generally rectangular-area scan within the perimeter of said limited field and for coordinating the operation of said scan-deflection means in a controlled program of limitation of one area scan within one perimeter limit before repeating such coordination within the next-successive perimeter limit in the series, the successively scanned areas being of varying width and symmetrical about a central axis aligned with said astigmatism axis, whereby ablative penetration to said maximum depth is the cumulative result of plural area scans of each of a succession of different but overlapping rectangular areas, with astigmatism-reducing cornea-curvature correction.

C 2 Cont'd.

~~26.~~ 4. Apparatus for performing ophthalmological surgery to reduce an ascertained astigmatic condition by selective ablation of the anterior surface of the cornea with penetration into the stroma to achieve a volumetric removal of corneal tissue, said apparatus comprising laser means having a chassis and producing an output beam in the ultraviolet portion of the electromagnetic spectrum and characterized by a spot which at eye impingement is small, in relation to the cornea to be operated upon, said laser means including

means for adjusting beam-exposure flux to a level at which corneal-tissue ablation per unit time is to an ascertained elemental depth which is but a fraction of desired maximum depth into the stroma region, scan-deflection means positioned for deflection of said beam in a limited field about a central axis, means for steadying the cornea with respect to said chassis and with the central area of the cornea centered on the central axis of scan deflection of said beam, said scan-deflection means having two coordinates of deflection for area coverage within the perimeter of said limited field, and control means for coordinating the operation of said scan-deflection means in a controlled program of area coverage to establish greatest cumulative beam exposure along the alignment of the central axis of symmetry of the ascertained astigmatic condition, with cumulative beam exposure decreasing smoothly as a function of increasing lateral offset on both sides of said central axis of symmetry.

C2 Cont'd.

~~27.~~ 5. Apparatus for performing ophthalmological surgery by selective ablation of the anterior surface of the cornea with varied penetration up to a predetermined maximum penetration into the stroma to achieve a cylindrical astigmatism-reducing anterior-curvature change by volumetric removal of tissue within the optically functioning area of the cornea, said apparatus comprising: a laser producing a pulsed laser beam in the ultraviolet region of the electromagnetic spectrum; means for shaping, focusing and directing the beam toward the eye with an intensity to produce tissue penetration to a depth per pulsed exposure which is but a fraction of said predetermined maximum; said means including means for selectively first determining and controlling a first rectangular area of exposure to the extent of at least said fractional depth and thereafter determining and controlling a second and different rectangular area of exposure to the extent of at least said fractional depth, each of said rectangular areas being symmetrically disposed on opposite sides of one and the same meridian of the cornea and within the optically functioning area of the cornea, wherein said meridian is selectable for orientation